

1. A multi-band voltage-controlled oscillator comprising:

- an oscillating transistor;
- a resonant circuit coupled between a base and collector of said oscillating transistor, said resonant circuit having an inductor and a capacitor coupled in parallel with each other;
- a buffer transistor coupled to an output of said oscillating transistor;
- a first output port coupled to an output of said buffer transistor;
- a variable-capacitance diode forming said capacitor;
- a control port from which a control voltage is applied to said variable-capacitance diode;
- a serial assembly having a first inductor and a second inductor coupled in series with each other for forming said inductor;
- first switching means made of a semiconductor for opening and short-circuiting both ends of said second inductor;
- a negative source generator coupled to the output of said buffer transistor;
- second switching means for selectively switching between an output of said negative source generator and a positive source;
- a mode switching circuit receiving an output frequency switching signal from an outside; and
- a package including said oscillating transistor, buffer transistor, negative source generator circuit, and mode

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to claim 1, wherein said first switching means includes a diode.

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7. A multi-band voltage-controlled oscillator comprising:  
an oscillating transistor;

a resonant circuit coupled between a base and collector  
of said oscillating transistor, said resonant circuit having  
5 an inductor and a capacitor connected in parallel with each  
other;

a buffer transistor coupled to an output of said oscillating  
transistor;

a first output port coupled to an output of said buffer  
10 transistor;

a variable-capacitance diode forming said capacitor

a control port from which a control voltage is applied to  
said variable-capacitance diode;

a serial assembly having a first inductor and second  
15 inductor coupled in series with each other for forming said  
inductor;

first switching means made of semiconductors for opening  
and short-circuiting both ends of said second inductor;

a negative source generator coupled to an output of said  
20 buffer transistor;

second switching means for selectively switching between  
an output of said negative source generator and a positive  
source, and for releasing an output to control an opening and  
short-circuiting operation of said first switching means to  
25 select between an oscillation output at a low frequency band  
and an oscillation output at a high frequency band released from  
said output port;

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a mode switching circuit receiving an output frequency switching signal received from an outside;

a package including said oscillating transistor, buffer transistor, negative source generator, and mode switching  
5 circuit integrated therein;

a third inductor and a fourth inductor coupled in series with each other between a collector of said buffer transistor and a source, each of said third and fourth inductors being formed with a pattern;

10 third switching means for opening and short-circuiting both ends of said fourth inductor according to an output of said second switching means,  
wherein said third inductor has an length of substantially  $1/4$  wavelength of an output frequency of the high band, and a  
15 composite pattern of said third and fourth inductors has a length of substantially  $1/4$  wavelength of an output frequency of the low band.

8. A multi-band voltage-controlled oscillator comprising:  
20 a first oscillating transistor;

a resonant circuit coupled between a base and collector of said first oscillating transistor, said resonant circuit having an inductor and a capacitor coupled in parallel with each other;

25 a first buffer transistor coupled to an output of said first oscillating transistor;

a first output port coupled to an output of said buffer

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transistor;

a variable-capacitance diode forming said capacitor;

a control port from which a control voltage is applied to said variable-capacitance diode;

5 a serial assembly having a first inductor and second inductor coupled in series with each other for forming said inductor;

first switching means made of semiconductors for opening and short-circuiting both ends of said second inductor;

10 a negative source generator coupled to an output of said first buffer transistor;

second switching means for selectively switching between an output of said negative source generator and a positive source, and for releasing an output to control an opening and short-circuiting operation of said first switching means to select between an oscillation output at a low frequency band and an oscillation output at a high frequency band released from said first output port;

20 a mode switching circuit receiving an output frequency switching signal from an outside;

a package including said first oscillating transistor, first buffer transistor, negative source generator, and mode switching circuit integrated therein;

a second oscillation transistor;

25 a parallel assembly coupled between a base and collector of said second oscillating transistor, said parallel assembly having an inductor and a capacitor coupled in parallel with each

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a second buffer transistor coupled to an output of said second oscillation transistor;

a second variable-capacitance diode forming said capacitor  
a control port through which a control voltage is applied  
to said second variable-capacitance diode; and

a fifth inductor forming said inductor,

9. A multi-band voltage-controlled oscillator according to claim 8,

wherein a ratio of the second frequency to the first frequency released from said first output port by frequency switching is not greater than 1.2, and

wherein a ratio of a third frequency released from said second output port to the first frequency is not smaller than 1.5.

10. A multi-band voltage-controlled oscillator according to claim 8,

wherein an oscillating operation of said second oscillating transistor is turned off when an output is released from said first output port, and

wherein an oscillating operation of said first oscillating transistor is turned off when an output is released from said second output port.

5        11. A multi-band voltage-controlled oscillator according to claim 8, further comprising:

        a logical adder circuit for calculating a logical addition of outputs of said first and second output ports; and

10        a third output port releasing an output of said logical adder circuit.

15        12. A multi-band voltage-controlled oscillator according to claim 10, further comprising a PLL circuit coupled to an output of said logical adder circuit, said PLL circuit being integrated in said package.

        13. A multi-band voltage-controlled oscillator according to claim 8, comprising:

        an oscillating transistor;

20        a resonant circuit coupled between a base and collector of said oscillating transistor, said resonant circuit having an inductor and a capacitor coupled in parallel with each other;

        a buffer transistor coupled to an output of said oscillating transistor;

25        a first output port coupled to an output of said buffer transistor;

        a variable-capacitance diode forming said capacitor;

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a control port from which a control voltage is applied to said variable-capacitance diode;

a serial assembly forming said inductor; said series assembly having a first inductor and a second inductor;

5 first switching means made of a semiconductor for opening and short-circuiting both ends of said second inductor;

a negative source generator coupled to as output of said buffer transistor;

10 second switching means for selectively switching between an output of said negative source generator and a positive source, and for releasing an output to control an opening and short-circuiting operation of said first switching means to select between an oscillation output at a low frequency band and an oscillation output at a high frequency band released from  
15 said first output port;

a mode switching circuit receiving an output frequency switching signal from an outside;

20 a package including said oscillating transistor, buffer transistor, negative source generator, and mode switching circuit integrated therein;

a first capacitor coupled in series or parallel with said variable-capacitance diode; and

switching means coupled between both ends of said first capacitor,

25 wherein said switching means makes frequency sensitivities at the low band and the high band equal to each other by an opening and short-circuiting operation thereof.

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14. A multi-band voltage-controlled oscillator according to claim 13, further comprising a second capacitor coupled in series with an assembly having said variable-capacitance diode  
5 and first capacitor.

15. A multi-band voltage-controlled oscillator according to claim 13, a second inductor coupled between two portions into which said first inductor is divided, said portions each having  
10 substantially an equal inductance.

16. A multi-band voltage-controlled oscillator according to claim 13, further comprising a capacitor coupled in parallel with said variable-capacitance diode.  
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17. A multi-band voltage-controlled oscillator according to claim 13, wherein said first and second inductors are formed with patterns.

20 18. A multi-band voltage-controlled oscillator according to claim 17, wherein after trimming said first inductor to adjust an output frequency at the high band, said second inductor is trimmed to adjust an output frequency at the low band.

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19. A multi-band voltage-controlled oscillator according to claim 18, further comprising:

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a multi-layer substrate including an inductor formed therein; and

a grounding pattern formed at said multi-layer substrate, said grounding pattern being not formed at a portion over which  
5 said inductor is formed.

20. A multi-band voltage-controlled oscillator according to claim 18, further comprising:

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10 a multi-layer substrate including an inductor formed therein; and

a via-hole formed in said multi-layer substrate for exposing a portion of said inductor to a surface of said multi-layer substrate,  
wherein a frequency can be adjusted by trimming said portion  
15 of said inductor.

21. A multi-band voltage-controlled oscillator according to claim 13,

wherein said switching means includes switching diodes  
20 being coupled between both ends of said first capacitor and being coupled between both ends of said second inductor, respectively, and

wherein a voltage generated in said package is applied to said switching diodes to control an opening and short-circuiting operation of said switching means.  
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22. A multi-band voltage-controlled oscillator according

to claim 13, wherein said first inductor is formed with a single inductor.

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